Coronal Jets in Active Regions

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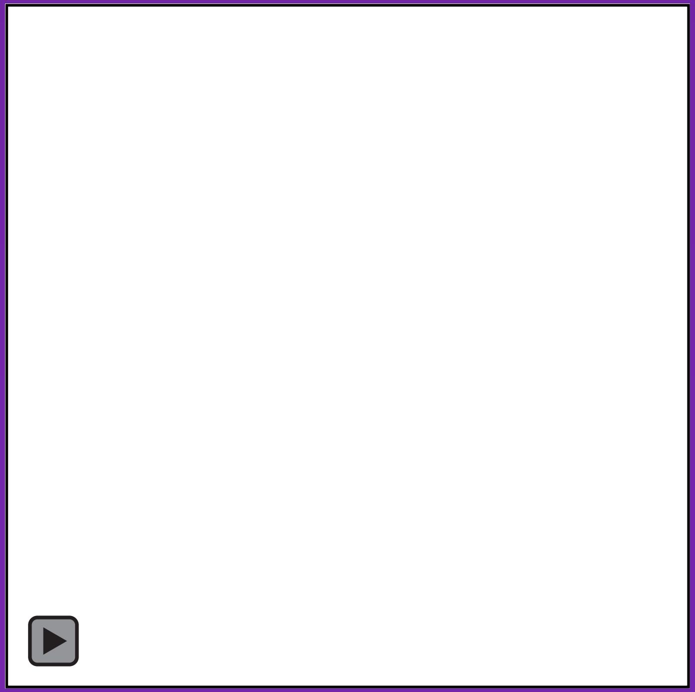
Overview

- Introduction
- Coronal Jets in polar coronal holes.
  - How we think they work.
- Quiet Sun jets, and how they work.
- Active region jets:
  - Example 1.
  - Example 2.
- Summary

Coronal Jets

- Well seen in X-rays (e.g., Shibata et al. 1992, Cirtain et al. 2007), and EUV (e.g., Nisticò et al. 2009).
- In polar coronal holes: size~50,000 km x 8000 km; rate ~60/day (Savcheva et al. 2007). Total energy ~10^{26}—10^{27} erg (Pucci et al. 2013).
- In active regions (ARs): Simlar appearance; longer ($\lesssim 10^5$ km); more energetic (~10^{27}—10^{29} erg; Shimojo & Shibata 2000) .
- Jets often have a "jet bright point" on one side of the jet's base.
- Good overviews/reviews include: Shimojo et al. (1994) Nisticò et al. (2009), Raouafi et al. (2016).

Cirtain et al. (2007)



(Thanks to K. Reeves)

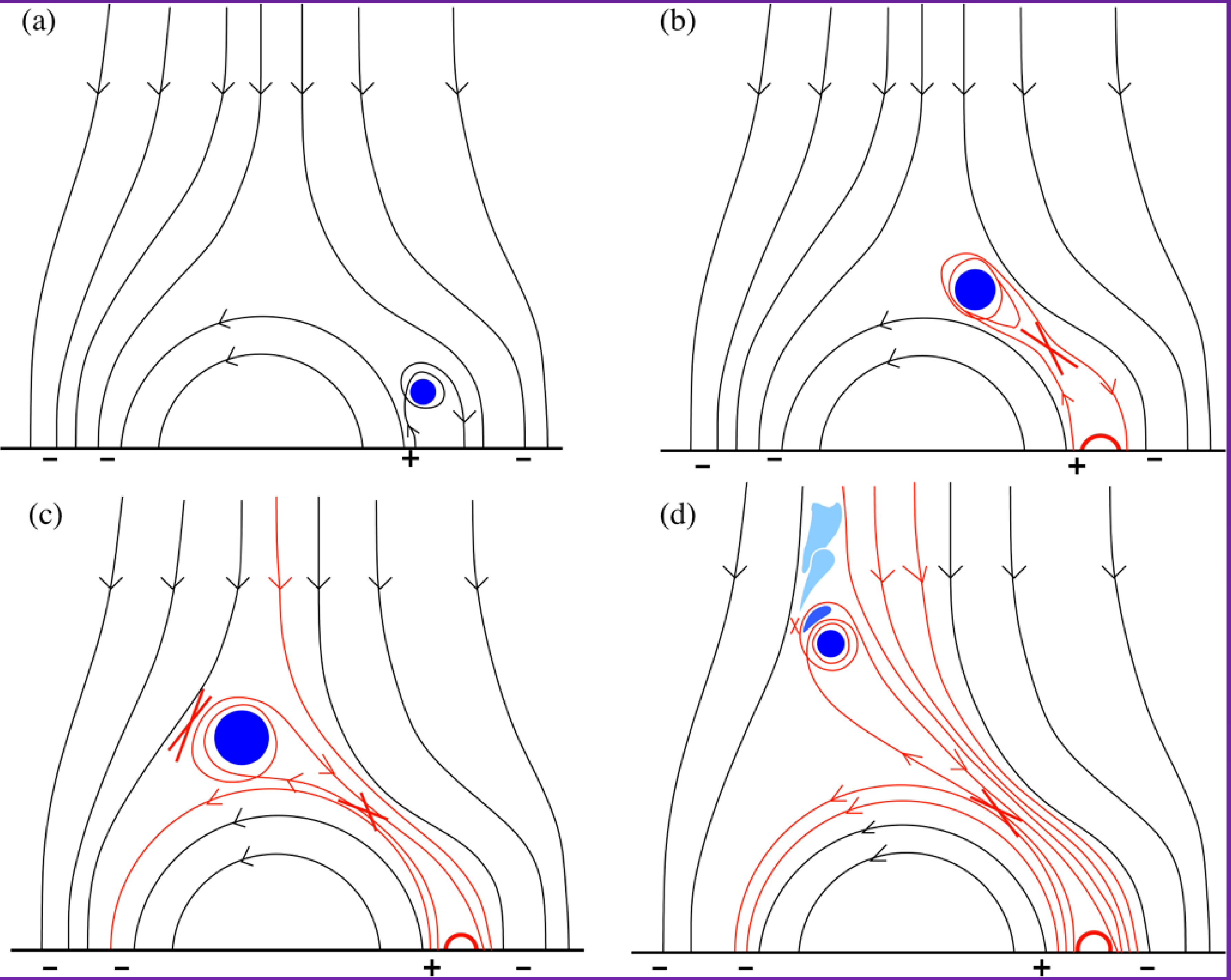
Minifilament Eruptions

XRT

AIA 193

Sterling et al. (Nature, 2015): 20 Polar CH jets.

“Normal” Filament Eruption (TRACE)



Sterling et al. (2015, 2016): "minifilament" eruptions.

Quiet Sun Jets - How We Think They Work:

Answer: The same as polar coronal hole jets!

(Panesar et al. 2016, ApJL; 10 quiet Sun jets)

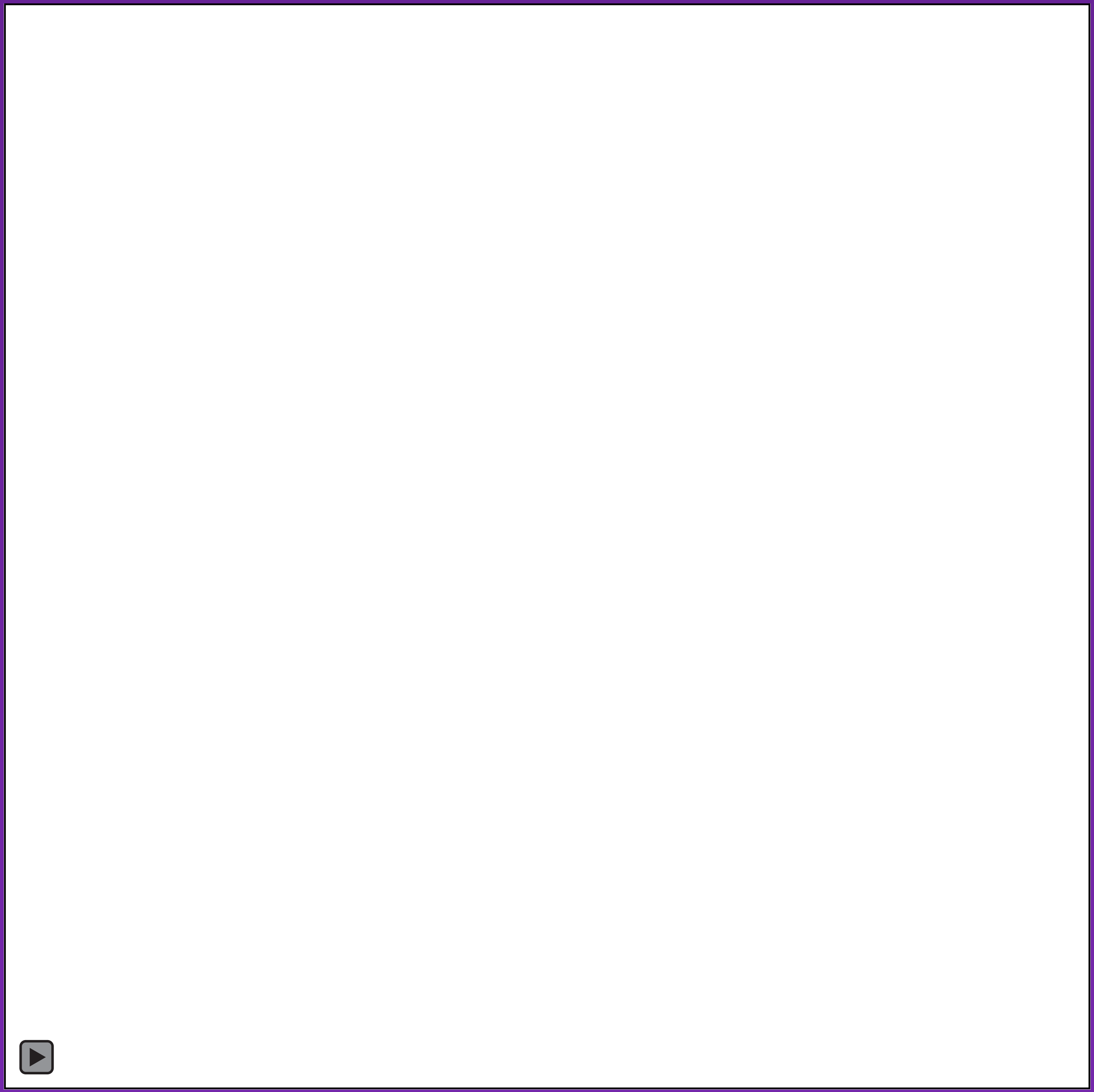
AIA 171

AIA 94

Active Region Jets: Example 1

- Single AR, AR 11513
- Only ~8-hr period, but many jets.
- AIA+HMI; no Hinode, but some SXI images.
- Sterling et al. (2016), ApJ

AIA 171



Sterling et al. (2016, ApJ)

AIA 304

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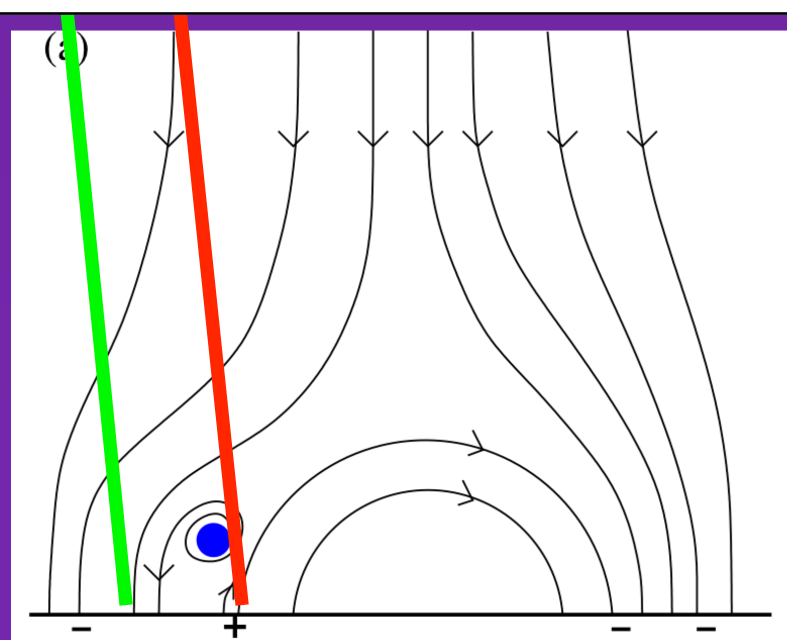

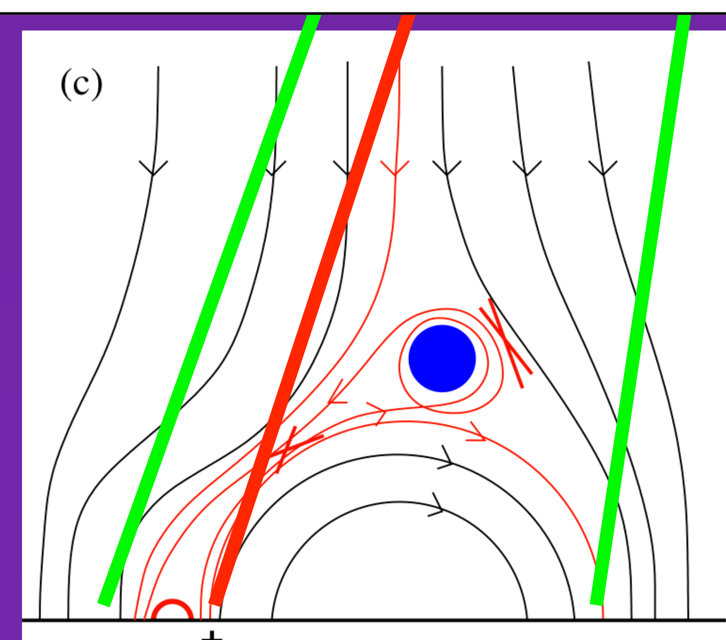

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AR Jet Example 2: To investigate further, look at a different AR:

- 14 Jan 2015 (NOAA AR 12259).
- AIA, HMI, Hinode, IRIS

Hinode/XRT

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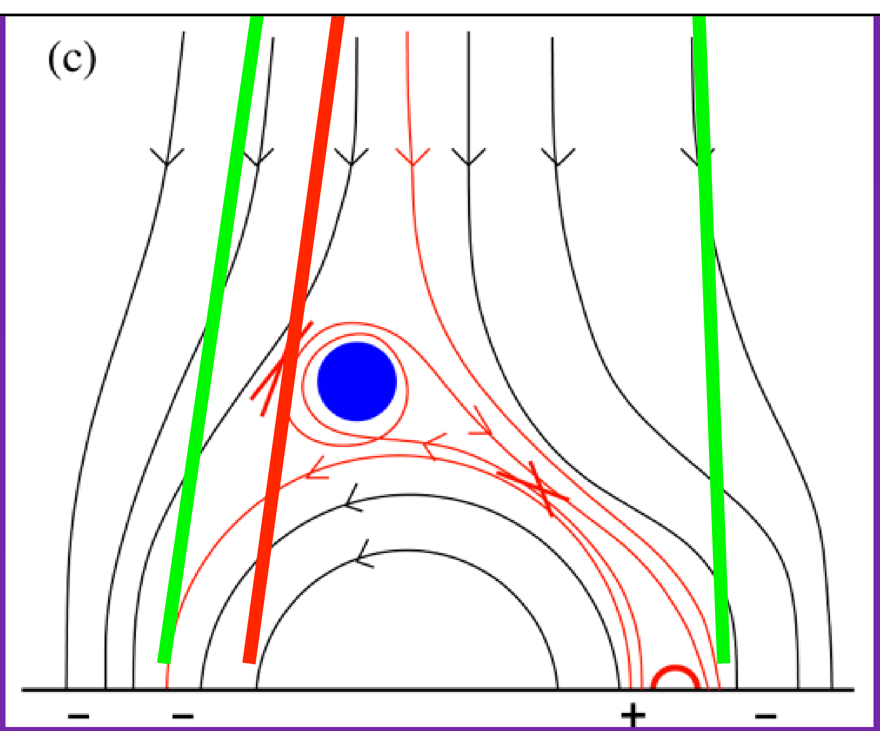

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HMI of IRIS-observed region:

Jets occur at *flux cancelation locations!

For this jet:

- This jet (actually, a series of jets) is consistent with the minifilament-eruption schematic.
- Minifilament itself however is not as clear as in other cases.
- Occurs at neutral line.
- Cancelation at the neutral line. (Strength? Gradient?).

Flux Cancelation Rates:

Preliminary values (Panesar et al. 2016; Sterling et al., in preparation):

- For quiet Sun jets: (1.7±0.7) x 10^{18} erg
- For AR jets: (0.5±1.0) x 10^{19} erg

Summary and Conclusions

- Detailed investigations of several AR jets.
- Among those we investigated:
  - Visually all fit the minifilament picture, from the magnetic-field setup standpoint.
  - Slower-buildup ones have obvious minifilaments.
  - Faster-buildup ones may have minifilaments, but of a different character than what we're used to (thinner, and maybe hidden by emission). Or maybe a different process.
- All occur on neutral lines.
- Frequently (if not always) there is flux cancelation occurring on the neutral lines. There are definitely cases of emergence+cancelation, and there may be cases of minifilament eruption triggered by emerging flux. (Cf. Mulay et al. 2016, others….)